PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventor: DOUGLAS DEWAR

821,053

Date of filing Complete Specification: Feb. 7, 1957.

Application Date: Feb. 28, 1956. *No. 6106/56.*

Complete Specification Published: Sept. 30, 1959.

Index at acceptance:—Class 135, V13H, VL(2D: 3D).

International Classification:—F06k.

COMPLETE SPECIFICATION

Fluid Pressure-Reducing Mechanism

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a fluid pressure-reducing mechanism.

Pressure-reducing mechanisms are known for both pneumatic and hydraulic fluids and usually comprise a normally-open valve controlled by a spring-loaded piston. Pressure fluid from the source flows through the valve and through an operating chamber to a mechanism to be operated. The piston is connected to the movable part of the valve and is slidable in the operating chamber against a spring, the arrangement being such that when the operating chamber pressure reaches a predetermined value the piston will have been moved by the pressure against its spring a distance sufficient to close the valve and prevent the further flow of pressure fluid.

The object of the present invention is to provide an improved pressure-reducing mechanism of this kind.

According to the present invention a fluid pressure reducing mechanism comprises a pressure chamber adapted to be connected to a source of fluid pressure, an operating chamber adapted to be connected to a device to be operated, a piston slidable in the operating chamber, a normally-open valve in the pressure chamber adapted to close a passage leading into the operating chamber, a lost motion device connecting the piston and valve, and spring means acting on the piston in a direction to open the valve, whereby the valve is maintained open by the spring-loaded piston until the pressure in the operating chamber reaches a predetermined value when said valve will close, and a rise in pressure in said operating chamber above said value moves said piston alone to uncover a passage connecting the operating chamber to exhaust or to a reservoir and allow excess pressure to flow thereto.

Preferably the valve is annular and is secured to one end of a metallic bellows, the other end of the bellows being secured to a wall of the pressure chamber. The effective seating diameter of the valve equals the effective diameter of the bellows so that the valve is balanced in the pressure chamber when it is closed. The piston spring is rated so that, on the predetermined operating chamber value being reached, it will have deflected sufficiently to close the valve. The lost motion connection is provided between a spindle of reduced diameter extending axially from a coaxial rod on the piston and the valve so that the piston may continue moving against the spring, after the valve has closed, to uncover axially-extending recesses in the wall of the operating chamber through which excess pressure fluid can flow past the piston and out to atmosphere or a reservoir.

One embodiment of the present invention will now be described with reference to the accompanying sectional drawing of a mechanism constructed in accordance with the invention and comprising a pneumatic pressure-reducing mechanism incorporating means to allow pressure in excess of a predetermined value to blow off to atmosphere. The mechanism illustrated comprises a housing 1 having a cylindrical bore 2 intermediate its ends, in which a piston 3 is fluid-tightly slidable. One side of the piston forms a wall 4 of an exhaust chamber 5 which is connected to atmosphere through a vent 6. A compression spring 7 is fitted to urge the piston 3 away from the vent 6. The other side of the piston 3 forms a wall 8 of an operating chamber 9 and this is adapted to be connected to a mechanism to be operated through an outlet connection 10. The end of the cylindrical bore 2 adjacent the vent 6 is provided with a plurality of angularly-equispaced axially-extending recesses 11, the arrangement being such that a predetermined movement of the piston 3 against

[*Price 3s. 6d.*]

Price 75p

the spring 7 uncovers the recesses 11 and allows pneumatic pressure from the operating chamber to flow past the piston to the exhaust chamber 5 and thence to atmosphere. It will be noted that as the piston 3 moves towards the exhaust outlet 6 the size of the exhaust chamber 5 becomes progressively less, its wall 4, which is the surface of the piston 3, moving as the piston 3 is moved.

The end of the housing 1 remote from the exhaust chamber 5 comprises a pressure chamber 13 which is adapted to be connected to a source of pneumatic pressure through the connection 14. A wall 15 separating said pressure chamber 13 and said operating chamber 9 is provided with passages 16 therethrough, said passages 16 being arranged symmetrically about the axis of the cylindrical bore 2. A metal bellows-member 17 has one end air-tightly secured to a wall 18 of the pressure chamber 13 directly opposite said passages 16 and an annular valve-member 19 is air-tightly secured to the other end of the bellows-member 17 and is adapted to air-tightly seat on a seating 20 formed on the wall 15 and encircling said passages 16, thereby to prevent the flow of air from the pressure chamber 13 to the operating chamber 9. The outer periphery 21 of the valve member 19 is cylindrical whilst the inner periphery tapers to provide a knife edge 23. The outside diameter of the valve member 19 is equal to the effective diameter of the bellows-member 17 and the arrangement of parts is such that, with the valve-member 19 closed, the pressure inside the pressure chamber 13 cannot act thereon to tend to lift it off its seating 20.

The piston 3 is connected to the valve member by a lost motion device comprising a rod 24 which extends axially through the operating chamber 9 and slidably through a guide 25 recessed in the wall 15 between the pressure and operating chambers co-axially of said piston 3. Passages 26 formed in said guide 25 coincide with said passages 16. The central portion 27 of the annular valve member 19 is abutted by the end 28 of the piston rod 24 and said valve member has a plurality of passages 12 therethrough. Said portion 27 is provided with a small diameter hole 29 through which a stem 30, extending axially from the end of the piston rod 24, is free to slide. The stem 30 terminates in an abutment 31, and a light spring 32 is fitted in compression between the abutment 31 and the portion 27 of the valve member 19.

In the inoperative position of the mechanism, the piston 3 is forced by its return spring 7 along its bore 2 and towards the valve 19, until the abutment 31 on the end of the stem 30 contacts the opposite end wall 18 of the housing 1, i.e. within the bellows-member 17. The piston rod 24 carries the valve member 19 with it, thus moving the valve 19 to an open position.

With the mechanism connected into a pneumatic system, it functions as follows. Pressure from a source enters the pressure chamber 13, passes through the open valve 19 to the operating chamber 9 and thence to the mechanism to be operated. This pressure acts on the piston 3 and as the pressure in the mechanism to be operated and in said operating chamber 9 increases, so the piston 3 is forced further down the bore against its compression spring 7. As the piston 3 progressively moves back so the valve-member 19, urged by the light spring 17 follows it, until the valve 19 is seated and the supply of pneumatic pressure from the source is cut off. The rating of the piston compression spring is arranged so that the predetermined cut-off pressure will have moved the piston 3 a sufficient distance to close the valve 19. In this balanced condition the piston 3 is situated adjacent the ends of the recesses 11 leading to exhaust 6.

It frequently happens that, due to the effects of heat, atmospheric changes and the like, the pressure in the operating chamber 9 rises above the predetermined value, even though the valve 19 is closed.

In the present invention means to prevent this from occurring are provided in that, if said pressure should increase, it forces the piston 19 further down the bore 2 until the adjacent ends of the recesses 11 connecting the operating chamber 9 and exhaust chamber 5 are uncovered. Pneumatic pressure thereby flows to exhaust until the correct operating chamber pressure is reached, when the piston spring 7 will move the piston 3 back to close the recesses 11 once more. During this phase of the operation the valve-member 19 remains seated, the piston stem 30 sliding through the hole 29. Only a small piston movement is required to connect the operating chamber 9 with exhaust and the rate of the piston spring 7 is so arranged that this movement takes place with only a very small increase in operating chamber pressure above the predetermined value.

An advantage of the pressure-reducing mechanism herein described is that it can be used in conditions which prevent the use of rubber or rubber-like seals. The piston 3 may if necessary be provided with a carbon sealing ring 34.

The exhaust chamber 5 may be dispensed with and the recesses 11 leading thereto may be replaced by holes in the wall 1 of the housing leading directly to atmosphere. The holes may be triangular in plan with an apex pointing axially towards the piston 3 so that, as the piston 3 moves further down the bore 2 the effective area of the aperture increases. The connection from the mechanism to the mechanism to be operated may be located at the end wall 18 of the housing 1, i.e. within the bellows-member 17. In this case air passes

through the passages 12 to the connection 10 through the bellows-member 17 when the valve 19 is open.

WHAT WE CLAIM IS:—

1. A fluid pressure reducing mechanism comprising a pressure chamber adapted to be connected to a source of fluid pressure, an operating chamber adapted to be connected to a device to be operated, a piston slidable in the operating chamber, a normally-open valve in the pressure chamber adapted to close a passage leading into the operating chamber, a lost motion device connecting the piston and valve, and spring means acting on the piston in a direction to open the valve, whereby the valve is maintained open by the spring-loaded piston until the pressure in the operating chamber reaches a predetermined value when said valve will close, and a rise in pressure in said operating chamber above said value moves said piston alone to uncover a passage connecting the operating chamber to exhaust or to a reservoir and allow excess pressure to flow thereto.

2. A mechanism according to claim 1 wherein the lost motion device comprises a coaxial rod on said piston which abuts said valve to move it in a valve-opening direction, a spindle of reduced diameter extending axially from the end of the rod and slidable in a hole formed centrally of said valve, and a helical spring on said spindle, the latter having one end engaging said valve to urge it towards the rod in a valve-closing direction, the opposite end of said spring engaging an abutment on said spindle.

3. A mechanism according to claim 2 wherein said valve comprises an annular substantially knife-edged valve member adapted to engage a valve seat on a wall dividing said pressure and operating chambers, the opposite face of said valve member being secured to one end of an annular corrugated bellows-member, the other end of which is secured to a wall of said pressure chamber remote from said operating chamber.,

4. A mechanism according to any preceding claim wherein said passage from said operating chamber to exhaust comprises a series of circumferentially equi-spaced axial recesses formed in the wall of said operating chamber, said piston being adapted to uncover said recesses to place said operating chamber in communication with exhaust upon a predetermined relative movement between said piston and said valve.

5. A mechanism according to claim 4 wherein said recesses are triangular in plan whereby movement of said piston relative to said valve is adapted progressively to open a greater area of the recesses to exhaust.

6. A fluid pressure reducing mechanism substantially as herein described and as illustrated in the accompanying drawing.

G. W. I. SHEAVYN,
Agent for the Applicants.

PROVISIONAL SPECIFICATION

Fluid Pressure-Reducing Mechanism

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1., do hereby declare this invention to be described in the following statement:—

This invention relates to a fluid pressure mechanism and more particularly relates to a pressure reducing mechanism for fluid pressure.

Pressure reducing mechanisms are known for both pneumatic and hydraulic fluids and usually comprise a normally-open valve controlled by a spring-loaded piston. Fluid pressure from the source flows through the valve and through an operating chamber to a mechanism to be pressurized. The piston is connected to the movable part of the valve and is slidable in the operating chamber against a spring, the arrangement being such that when the operating chamber pressure reaches a predetermined value the piston will have been moved by the pressure and against its spring a distance sufficient to close the valve and prevent the further flow of fluid pressure.

The object of the present invention is to provide an improved pressure reducing mechanism of this kind.

According to the present invention a fluid pressure reducing mechanism comprises a pressure chamber adapted to be connected to a source of fluid pressure, an operating chamber adapted to be connected to a device to be operated, a piston slidable in the operating chamber, a normally-open valve in the pressure chamber adapted to close a passage leading into the operating chamber, means slidably interconnecting the piston and valve, and spring means acting on the piston in a direction to open the valve, whereby the valve is maintained open by the spring-loaded piston until the pressure in the operating chamber reaches a predetermined value when said valve will close, and a rise in pressure in said operating chamber above said value moves said piston alone to uncover a passage connecting the operating chamber to exhaust or to a liquid reservoir and allow excess pressure to flow thereto.

Preferably the valve is annular and is secured to one end of a metallic bellows, the other end of the bellows being secured to a wall of the pressure chamber. The effective seating diameter of the valve equals the effective diameter of the bellows so that the valve

is balanced in the pressure chamber when it is closed. The piston spring is rated so that, on the predetermined operating chamber value being reached, it will have deflected sufficiently to close the valve. A sliding connection is provided between a rod extending axially from the piston and the valve so that the piston may continue moving against the spring, after the valve has closed, to uncover axially-extending passages in the wall of the operating chamber through which excess pressure fluid can flow past the piston and out to atmosphere or a liquid reservoir.

One embodiment of the present invention will now be described comprising a pneumatic pressure reducing mechanism incorporating means to allow pressure in excess of a predetermined value to blow off to atmosphere. This mechanism comprises a housing having a cylindrical bore intermediate its ends in which a piston is fluid-tightly slidable. One side of the piston forms a wall of an exhaust chamber which is connected to atmosphere through a vent. A compression spring is fitted to urge the piston away from the vent. The other side of the piston forms a wall of an operating chamber and this is adapted to be connected to a mechanism to be operated through an outlet connection. The end of the cylinderical bore adjacent the vent is provided with a plurality of angularly-equispaced axially-extending passages, the arrangement being such that a predetermined movement of the piston against the spring uncovers the passages and allows pneumatic pressure from the operating chamber to flow past the piston to the exhaust chamber and thence to atmosphere.

The end of the housing remote from the exhaust chamber comprises a pressure chamber which is adapted to be connected to a source of pneumatic pressure. A wall separating said chamber and said operating chamber is provided with a passage therethrough, said passage being co-axial with the piston. A metal bellows-member has one end fluid-tightly secure to a wall of the pressure chamber directly opposite said passage and an annular valve-member is fluid-tightly secured to the other end of the bellows-member and is adapted to fluid-tightly seat on a seating encircling said passage, thereby to prevent the flow of pneumatic fluid from the pressure chamber to the operating chamber. The outer periphery of the valve member is cylindrical whilst the inner periphery tapers to provide a cylindrical seating edge. The outside diameter of the valve member, the effective diameter of the bellows-member and the arrangement of parts is such that, with the valve-member closed, the pressure inside the pressure chamber cannot act thereon to tend to lift it off its seating.

The piston is provided centrally with a rod which extends axially through the operating chamber and slidably through a guide provided in the passage between the pressure and operating chambers. The annular valve member is provided with a central portion against which the end of the piston rod abuts. Said portion is provided with a smaller diameter hole through which a stem, extending axially from the end of the piston rod, is slidably fitted. The stem terminates in an abutment, and a light spring is fitted in compression between the abutment and the central portion of the valve member.

In the inoperative position of the mechanism, the piston is forced by its return spring along its bore and towards the valve, until the abutment on the end of the stem contacts the opposite end wall of the housing, i.e. within the bellows-member. The piston rod carries the valve member with it, thus moving the valve to an open position.

With the mechanism connected into a pneumatic system, it functions as follows. Pressure from a source enters the pressure chamber, passes through the open valve to the operating chamber and thence to the mechanism to be operated. This pressure acts on the piston and as the pressure in the mechanism to be operated and said operating chamber increases so the piston is forced further down the bore against its compression spring. As the piston progressively moves back so the valve-member, urged by the light spring between the central portion and the stem abutment, follows it, until the valve is seated and the supply of pneumatic pressure from the source is cut off. The rating of the piston compression spring is arranged so that the predetermined cut-off pressure will have moved the piston a sufficient distance to close the valve. In this balanced condition the piston is situated adjacent the ends of the passages leading to exhaust.

It frequently happens that, due to the effects of heat, atmospheric changes and the like, the operating chamber pressure rises above the predetermined value, even though the valve is closed.

In the present invention means to prevent this from occurring are provided in that, if said pressure should increase, it forces the piston further down the bore until the ends of the passages connecting the operating chamber and exhaust chamber are uncovered. Pressure fluid thereby flows to exhaust until the correct operating chamber pressure is reached, when the piston spring will move the piston back to close the passages once more. During this phase of the operation the valve-member remains seated, the piston stem sliding through the hole in the central portion thereof. Only a small piston movement is required to connect the operating chamber with exhaust and the rate of the piston spring is so arranged that this movement takes place with only a very small increase in operating chamber

pressure above the predetermined value.

An advantage of the pressure reducing mechanism herein described is that it can be used in conditions which prevent the use of rubber or rubber-like seals. The piston may if necessary be provided with a carbon sealing ring.

The exhaust chamber may be dispensed with and the passages leading thereto may be replaced by holes in the wall of the housing leading directly to atmosphere. The holes may be triangular shaped with an apex pointing towards the piston so that, as the piston moves further down the bore the aperture increases. The connection from the mechanism to the mechanism to be operated may be located at the end wall of the housing, i.e. within the bellows-member.

G. W. I. SHEAVYN,
Agent for the Applicants.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1959.
Published by The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

821,053 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.